AMENDMENTS TO THE SPECIFICATION

[0006] One proposed solution is the use of computerized tomography (CT) volumetric X-ray imaging in radiation treatment rooms. Examples are CT-on-rail and cone beam CT using a gantry mounted imaging system, such as the On Board Imager™ by Varian Medical Systems, Inc. of Mountain View, California~~on-board imaging (OBI)~~, or a portal imaging device. The boundaries of some soft tissue targets are more visible in CT slices. They can be contoured in the collection of slices that span the target volume thus delineating the target in 3D in much the same way as is done for treatment planning with CT images. To be clinically effective, the in-room CT as an online imaging modality requires both fast volumetric image reconstruction and fast CT contouring capability. Even if fast and reliable 3D contouring becomes available, the in-room CT equipment entails added cost and, in the case of CT-on rail, inhibiting space requirements for some clinics.

[0053] In the second modality, the markers 110 may also be imaged as illustrated by enlarged image 195 of Figure 1B, however, the sensor device 100 may not be imagable in this second modality as shown by the absence of sensor device 100 in enlarged image 195 of Figure 1B. In such an embodiment, the ~~senor~~sensor device 100 may be identified in the previously established coordinate system using image processing software to relate the positions of the array of markers seeds in the second imaging modality with their positions in the first imaging modality. The location in the body 105 of sensor device 100 imaged in the first modality is determined. When the position of the array of markers 110 in the second modality (illustrated by enlarged image 195) is identified in the coordinate system, the location of the sensor device 100 may be then calculated in the internal coordinate system (i.e., relative to one or more markers 110) and displayed with a computing system as discussed below in relation to Figure 4. The localization process is discussed in more detail below in relation to Figure 6.

[0054] As such, even though sensor device 100 cannot be imaged in second modality 195 of Figure 1B, the location of sensor device 100 in body 105 may be known relative to the array of markers 110. This, in turn, can be related to various anatomical landmarks viewable by the imaging modalities. Accordingly, the location of sensor device 100 can also be known relative to anatomical landmarks. Movement of the ~~senor~~sensor device 100 caused by, for example, motion of the part of the body in which sensor device 100 is situated can also be measured so that location of the device over an integral of time can be directly calculated or mathematically modeled and predicted. Tracking 3D position verses time may be performed as discussed below in relation to Figure 6. In one embodiment, the resulting trajectory of the markers may then be processed using a predictive filter, for example, as discussed in pending U.S. patent application 09/178,383 titled, "METHOD AND SYSTEM FOR PREDICTIVE PHYSIOLOGICAL GATING OF RADIATION THERAPY," which is herein incorporated by reference. Alternatively, other predictive filters known in the art may be used.

[0063] As previously noted, the markers 200 and/or imaging properties may be disposed in various locations on sensor device 100 and in different patterns on sensor device 100. As such, the orientation of sensor device 100 can be determined through the use of multiple markers 200 of Figures 2A, 2B or multiple imaging property regions (e.g., 310 and 320) of Figure 3. If several ~~senor~~sensor devices 100 are placed in the body 105, they may each have different marker properties such as through means of multiple imaging markers disposed thereon/therein or multiple imaging properties integral in the sensor device's construction (e.g., part of its casing), thereby making it possible to determine specific device location as well as a device's orientation.

[0064] One or more of ~~senor~~sensor device 100 and markers 110 may be localized by an image system as illustrated in Figure 4. Figure 4 illustrates one embodiment of a system 400 that represents a treatment planning and/or delivery system. While at times discussed in relation to a treatment planning system, system 400 also represents a

treatment delivery system. As such, beam 402 may represent both an imaging beam and a treatment beam depending on the context of the discussion. The planning system and the treatment system may be physically different machines or incorporated together within a machine. In one embodiment, for example, the delivery system may be, for examples, a Clinac® Linear Accelerator and a Multi-Leaf Collimator (MLC™) available from Varian Medical Systems, Inc. of California. The configuration of system 400 shown is only for ease of discussion and illustration purposes and various other configuration known in the art may be used, for example, imager 405 may be located on a gantry rather than incorporated into treatment table 404. It should also be noted that the imaging system 400 may be discussed in relation to particular imaging modalities only for ease of discussion and that other imaging modalities may be used as mentioned above.